(12) UK Patent Application (19) GB (11) 2 149 484 A

(43) Application published 12 Jun 1985

(21) Application No 8426327

(22) Date of filing 18 Oct 1984

(30) Priority data

(31) 8317647 (32) 7 Nov 1983 (33) FR

(51) INT CL^4
F24H 1/44

(52) Domestic classification
F4A N14 N1E3

(56) Documents cited
GB A 2129915 EP 0092838
GB A 2043850 EP 0033229

(58) Field of search
F4A

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(54) Condensation boiler

(57) A condensation boiler comprises a principal exchanger and an auxiliary condensation exchanger recovering heat contained in the exhaust gases, the auxiliary exchanger (28) being placed vertically in an airtight duct (26) preferably of stainless steel arranged in the rear part (22) of the boiler between the outlet for gases (18) from the boiler and the discharge for the gases to the atmosphere.

FIG. 1

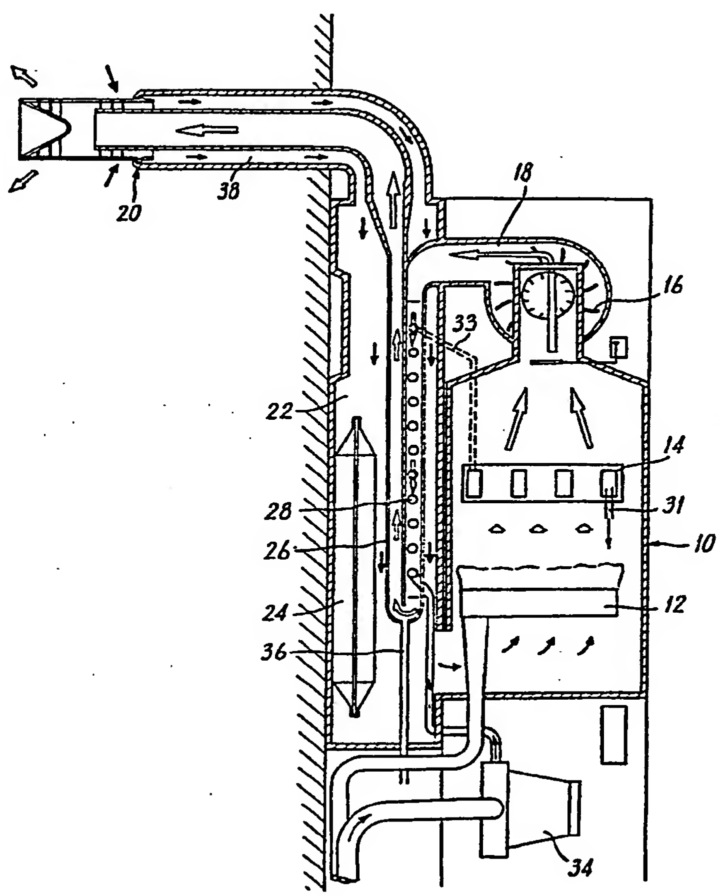

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FIG. 1

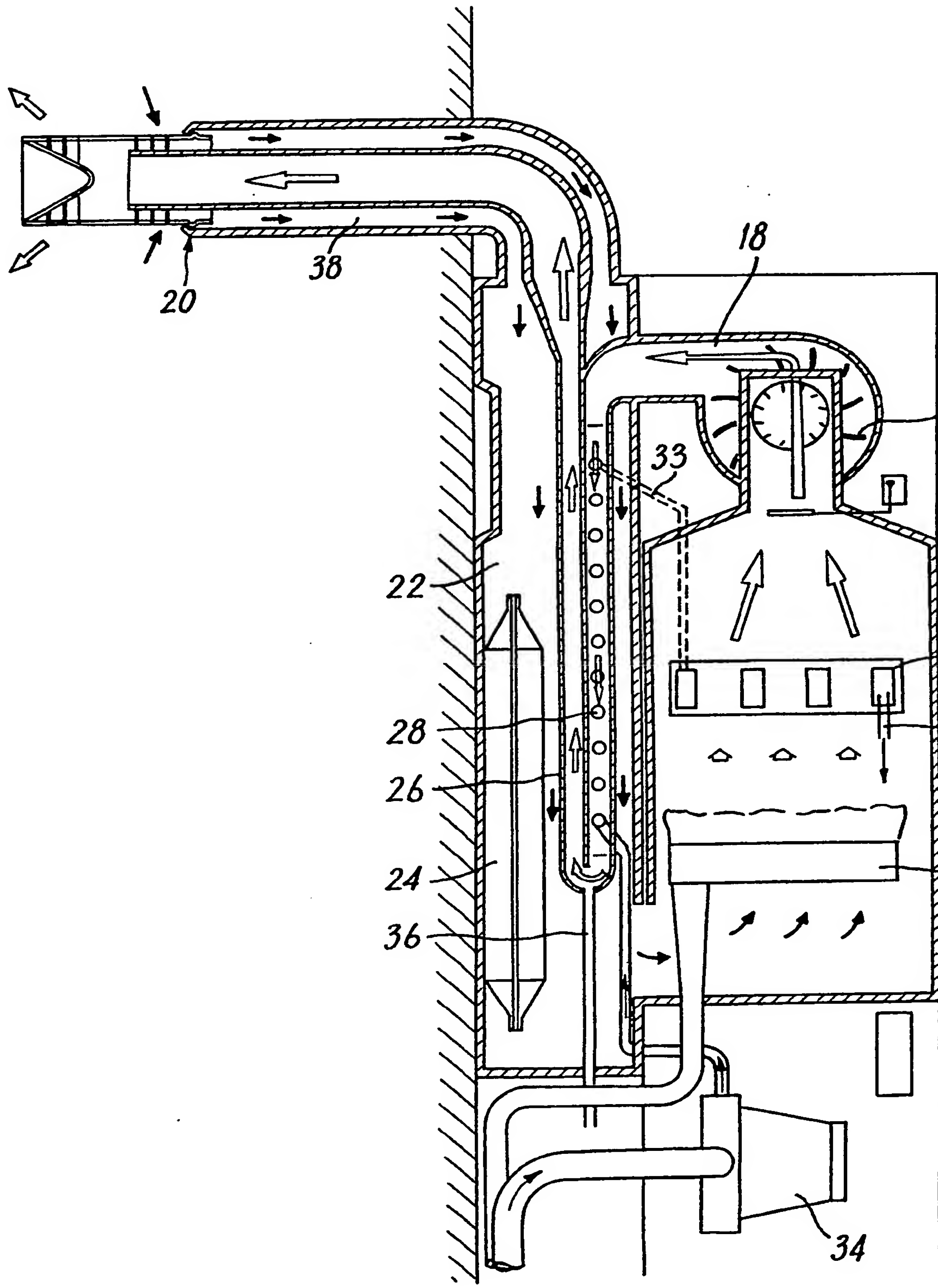

FIG. 2

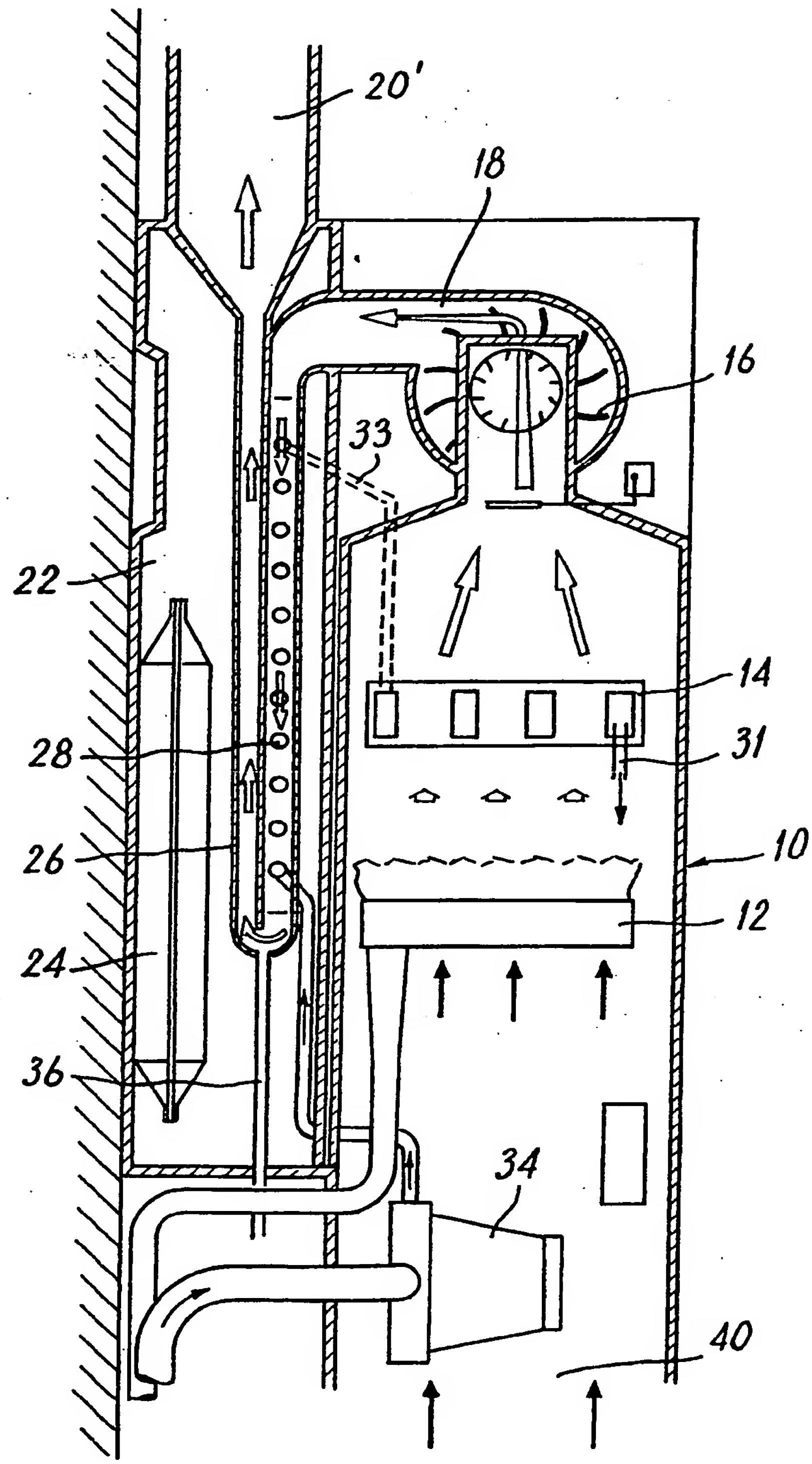

FIG. 3

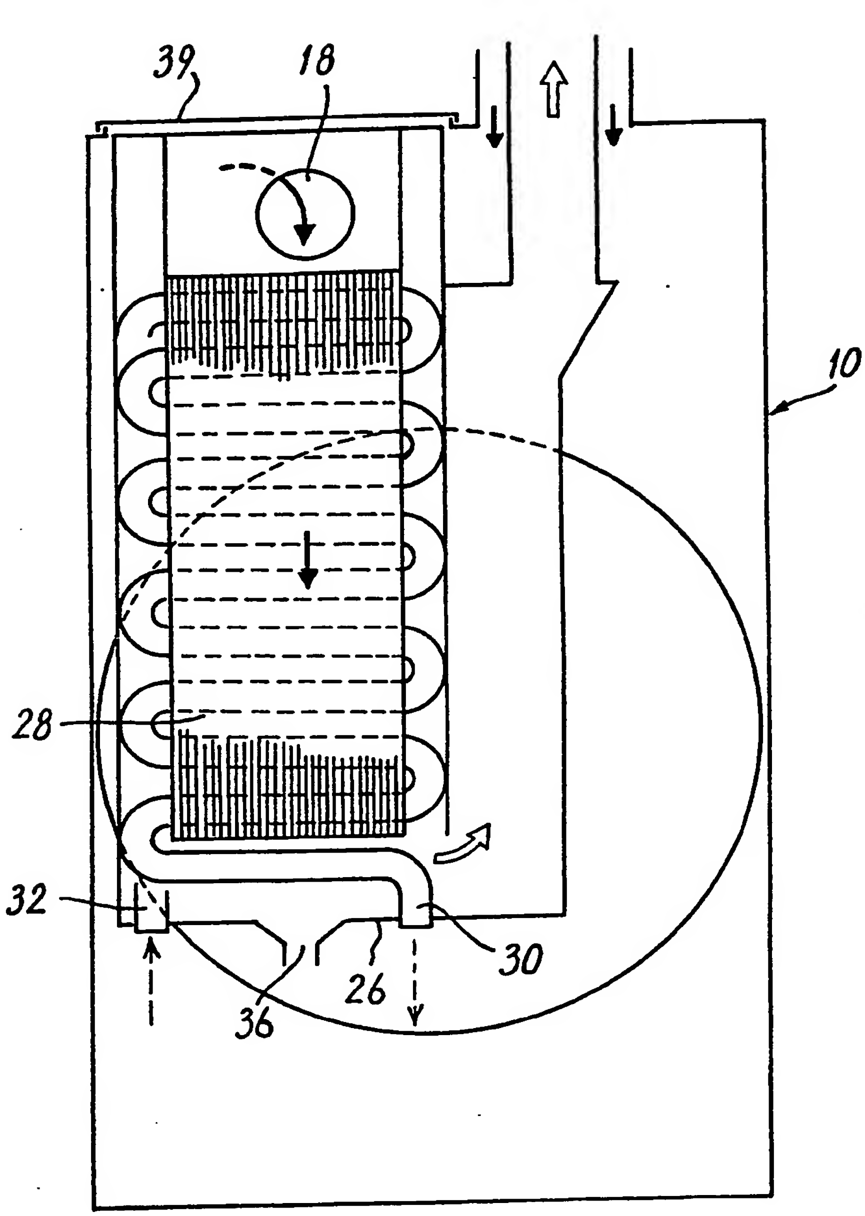

Fig.5

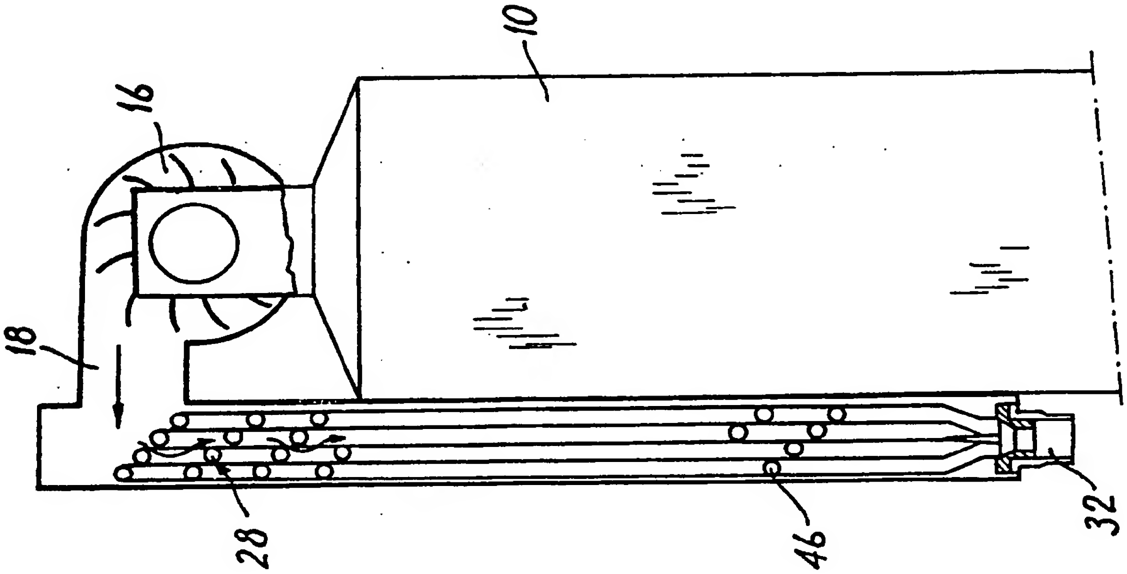

Fig.4

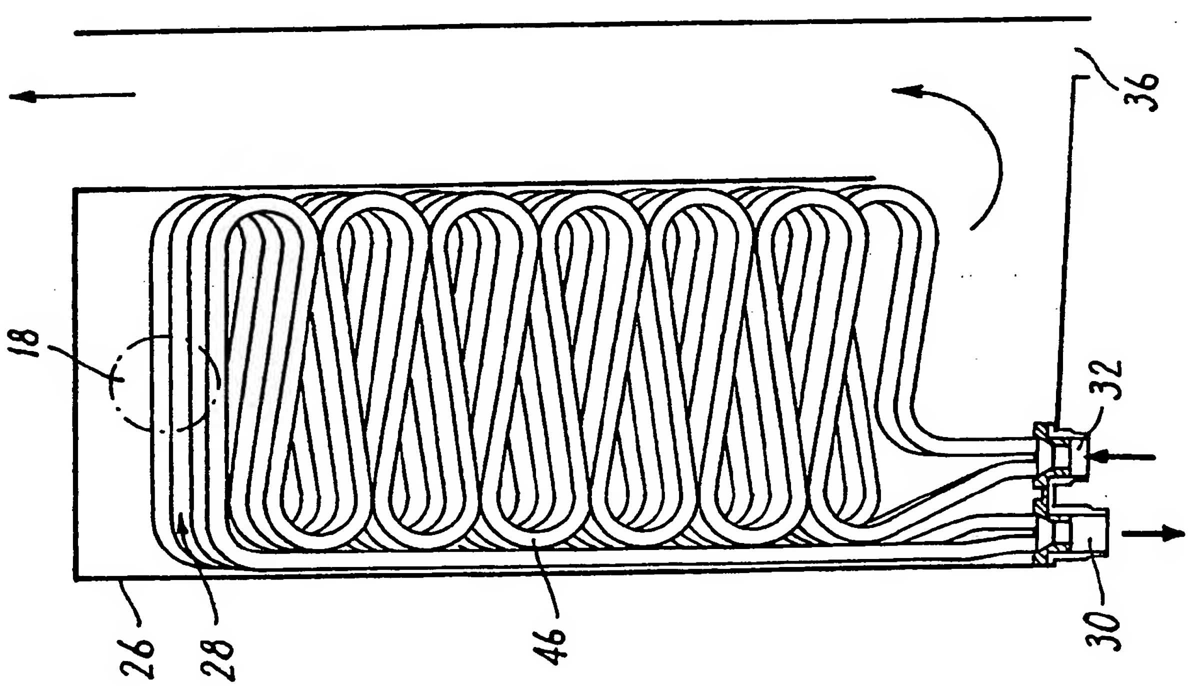

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FIG.7

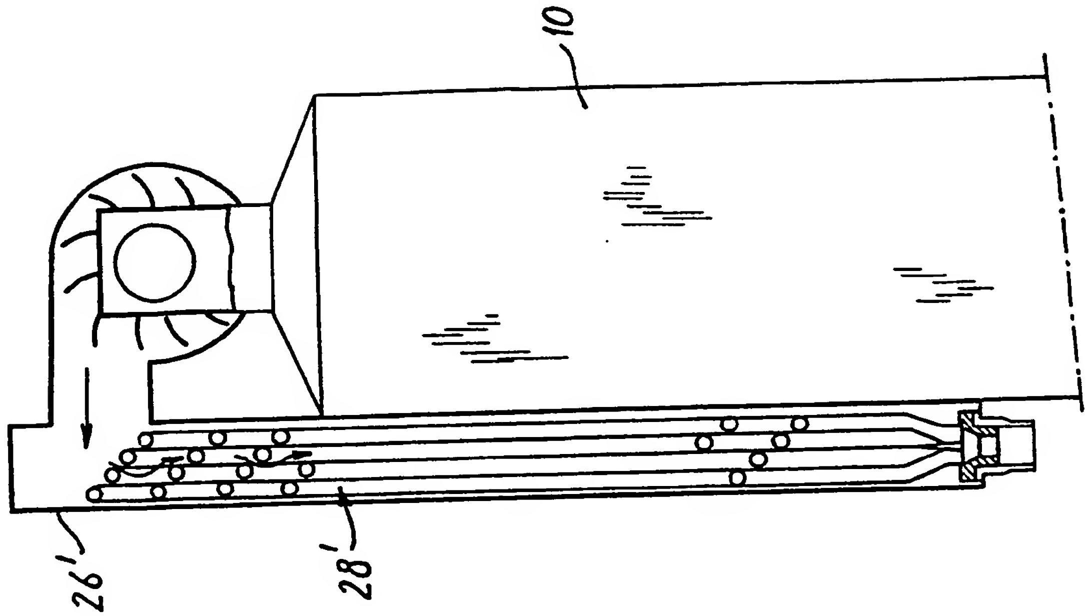
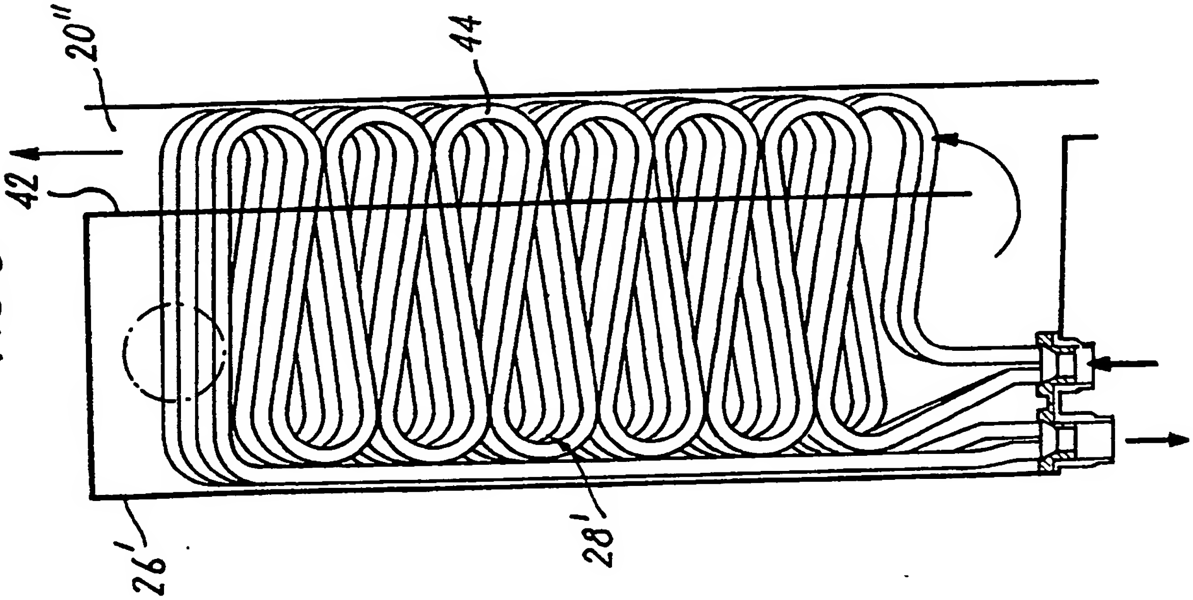


FIG.6



SPECIFICATION
Condensation boiler

The present invention relates to a boiler known as a "condensation boiler", that is a boiler comprising a condenser allowing recovery of heat contained in the exhaust gases, at the outlet of the boiler, which gases are generally discharged in the system for removal of burnt gases.

It is known that a boiler of known type, especially a gas-fired boiler, discharges the products of combustion at a relatively high temperature and that these products contain a large amount of water vapour. It has been suggested to cool these combustion products to condense the water vapour which they contain and cover the latent heat of evaporation. For this purpose there has been used an auxiliary heat exchanger placed in the path of the gases to recover the major part of the heat and transfer it to a heating circuit.

There are known various types of condensation boiler which comprise a principal exchanger and an auxiliary exchanger mounted in the path of the gases after their passage through the principal exchanger. In these known boilers the auxiliary exchanger is generally placed above the auxiliary exchanger, preferably in the smoke box of the boiler, and is inclined to the horizontal to facilitate removal and collection of the condensed water.

These boilers are generally satisfactory but they have the disadvantage of being expensive to construct and give problems which are difficult to solve, especially in connection with their maintenance, because of the position of the auxiliary exchanger.

The present invention is intended to reduce the disadvantages of known types of condensation boiler while allowing easy and economic provision of a condensation boiler starting from a boiler of known type.

The invention provides a condensation boiler of the type comprising a principal exchanger and an auxiliary exchanger allowing recovery of heat contained in the exhaust gases, characterised in that said auxiliary exchanger is placed vertically in a gas-tight duct, preferably of U-shape and of stainless steel, situated outside the active part of the boiler, between the conduit for removal of exhaust gases from the boiler and discharge of these gases to the atmosphere, this duct preferably comprising at its lower part a conduit for removal of condensate.

In one embodiment of the invention the auxiliary exchanger is a body of fins, the fins being arranged vertically and having passing through them the feed tube for water to be heated which leads towards the principal exchanger. Preferably the lower end of each fin is of pointed shape in order to favour flow of the condensed water and to ensure free passage between the fins for the products of combustion.

The gas-tight duct may comprise a movable hermetic cover allowing access from above to the auxiliary exchanger.

In one embodiment of the invention said auxiliary exchanger is formed by a plurality of identical flat coils, four in number for example, mounted in a "skeined" configuration and fed by a single distributor which receives the return flow of water from the heating circuit.

In one arrangement the assembly of "skeined" coils is arranged in a parallelepipedal box which directs the gases downwardly and which comprises a conduit for removing condensate, placed at its lower part, the condensate moving in the same direction as the gas.

The invention is applicable both to boilers having a vent and to boilers discharging through a chimney in known manner.

Embodiments of the invention will now be described, by way of example and not by way of limitation, with reference to the accompanying drawings which show two possible arrangements. In the drawings:

Figure 1 is a schematic vertical cross-section of a first type of boiler according to the invention, used extraction through a vent,

Figure 2 is a schematic section, similar to Figure 1, of a second type of boiler according to the invention using extraction through a chimney,

Figure 3 is a front view of the auxiliary exchanger in the boilers of Figures 1 and 2,

Figure 4 is a front view of another of auxiliary exchanger for use in the boilers of Figures 1 and 2,

Figure 5 is a schematic vertical section of a boiler provided with a heat exchanger as shown in Figure 1, and

Figures 6 and 7 are views similar to Figures 4 and 5 relating to another embodiment.

Referring to the drawings, a boiler 10 comprises in known manner a burner 12, a heat exchanger 14 placed immediately above the burner in the path of the burnt gases, an extractor 16 and a conduit for removal of burnt gases 18. In the arrangement of Figure 1 the boiler has a vent 20 whereas in the arrangement of Figure 2 the boiler uses discharge through a chimney.

In both cases there is provided a second exchanger to ensure recovery of heat contained in the exhaust gases (this exchanger is generally called a "condensation generator") which is positioned in the rear part 22 of the boiler containing the expansion tank 24, outside the active part of the boiler. This auxiliary condensation exchanger 28 is positioned in an airtight duct 26, preferably U-shaped and of stainless steel, which is placed between the discharge of gas to the exterior, 20 or 20', and the outlet 18 of the extractor 16. This exchanger 28, arranged vertically in the airtight duct 26, comprises a body of vertical fins and has passing through it a return tube 30 for the heating water leading to the principal exchanger 14. At the input 32 to the body of tubes of the auxiliary exchanger 28, the tube 32 is connected to the return of the heating installation (radiators for central heating), forced circulation of the water being caused by impeller 34. At its lower part the air-tight duct 26 is provided with a tube for removal of condensate 36 closed by a float device (not shown in the drawings). The lower end of each fin has, preferably, a pointed shape in order to favour flow of the condensed water and to clear the passages between the fins for

the products of combustion.

In the arrangement of Figure 1 cold air is admitted through conduit 38, the burnt gases passing through the principal exchanger 14 and being impelled by extractor 16 through the conduit 18 to pass through the auxiliary exchanger 28 before being discharged to the exterior through vent 20. The burnt gases first transfer their heat to exchanger 14, heating the water entering the exchanger through conduit 33. The burnt gases then arrive at exchanger 28, at a temperature which is still quite high, and they transfer the remainder of their heat, by condensation, to water which passes through this exchanger 28. The water arrives in this auxiliary exchanger 28 from the return of the heating circuit, it is passed to the principal exchanger 14 through the conduits 30, 33 and the reheated water is passed to the central heating radiators by conduit 31. There is thus obtained a maximum yield, the gases discharged to the exterior being at a very low temperature.

The condensed water produced in the auxiliary exchanger 28 is collected at the bottom of the airtight duct 26 and discharged through pipe 36. As mentioned above there is provided a float device to avoid any discharge of burnt gases through the tube 36 when there is no condensation, this float acting as a non-return valve.

The gas-tight duct 26 is provided with an opening, at its upper part, obturated hermetically by a cover 39 (Fig. 3). It is thus very easy to dismantle the auxiliary exchanger 28, should this be necessary.

In the variant shown in Figure 2 there is used discharge from the boiler through chimney 20'. In this boiler cold air is taken directly from the room in which the boiler is placed, the boiler otherwise being identical to that of Figure 1.

The principal advantage of the arrangements described is that of allowing easy provision of a condensation boiler from a known boiler.

Also the extractor 16 of the boiler is not subject to corrosion, as it is not situated in a zone exposed to condensate, which is not the case in known condensation boilers where the extractor is often placed after the condensation exchanger.

The variant shown in Figures 4 to 7 differs from the above in the design of the auxiliary exchanger.

In this variant, the auxiliary heat exchanger 28 is formed of 4 identical planar coils 46 (other numbers of coils may of course be used) mounted as shown in the Figures in a "skeined" formation, that is the axes of the different tubes which form the coils are separated one from another. The coils are fed by a single distributor 32 through which arrives the water to be reheated from the return of the heating circuit supplied by the boiler 10.

The assembly of coils of exchanger 28 is positioned in a parallelepipedal box forming a gas-tight duct 26, comprising a discharge 36 for condensate at its lower part, this box leading the gases downwardly. The burnt gases obtained from boiler 10, after passing through the principal exchanger (not shown in Figures 4 to 7) of the boiler, as described above, are fed to the parallelepipedal box 26 through conduit 18, through which they are impelled by extractor 18.

The burnt gases which arrive at the auxiliary exchanger 28 are at a temperature which is quite high and they transfer the remainder of the heat, especially by condensation, to the water which passes through the coils of exchanger 28. The water arrives through distributor 32, from the return of the heating circuit, is reheated in the coils of exchanger 28 and is then passed to the principal exchanger of boiler 10 through conduit 30.

In order to adapt the auxiliary exchanger described above to different conditions of use (such as power, bulk, pressures etc.) it is possible to provide two paths of passage for the products of combustion.

In the arrangement of Figs. 4 and 5 the assembly of coils 46 is arranged in the box 26 and the exchanger is only traversed once by the combustion gas obtained from boiler 10, whereas in the embodiment of Figures 6 and 7 the partition 42 of the box 26' containing the coils is arranged to separate the bundles of coils so that part 44 of the coils are situated in the evacuation conduit 20" of the gases.

This variant gives an auxiliary heat exchange which is simple, compact, optimises the heat exchange by condensation, and gives a hydraulic flow which facilitates protection against corrosion and compatibility between the losses of pressure of the water and discharged gases and the pressures available in a wall-mounted gas boiler.

The advantages obtained include:

(A) Ease of Use

The particular design and arrangement of the coils maximise, in the volume used, the radii of curvature of the tubes, so as to facilitate their curving.

The fact that all the coils are identical allows largely automatic shaping without complex tools and the use of numerically controlled curving machines.

The geometrical characteristics of the coils (diameters, radii of curvature . . .) are such that this exchanger may be made of different metals such as copper, stainless steel or aluminium.

The attention which has been given to the study of heat exchange allows design of an efficient exchanger whatever metal is used.

(B) Optimisation of Heat Exchange

The absence of any fin reduces to the maximum extent the thermal resistance between the water and the gases and allows obtaining near the whole of the heat exchange surface of a large gradient of partial pressures of water vapour, and thus very good exchange by condensation.

In spite of the low velocity of the discharged gases, the mounting of the coils in "skeined" fashion increases turbulence and gives local coefficients of exchange by convection of value greater than those obtained with laminar flow.

The flow of gases in the direction of the condensate, and also the smooth surfaces of the tubes, ensures rapid removal of the condensate.

The thickness of the film of water on the walls of the tube, which is always small, does not interfere with heat exchange and allows a mode of formation of condensate which approaches dropwise condensation.

(C) Good Resistance to Corrosion

As there is no local concentration of condensate due to re-evaporation in dead angles or along edges taking place during flow (as is found with finned exchangers) the design of the exchanger ensures its resistance to corrosion over a long period of time.

In particular, the space between the loops of the coils allows natural flow of condensate downwardly and prevents enrichment substances which might be present at locations where it could stagnate and evaporate before receiving more drops of condensate during intermittent cycles of operation, for example during supply of hot water for domestic purposes.

CLAIMS

1. A condensation boiler of the type comprising a principal exchanger and an auxiliary condensation exchanger for recovering heat from exhaust gases, characterised in that the auxiliary exchanger is positioned vertically in an airtight duct, preferably made of stainless steel, situated outside the active part of the boiler between a conduit for removing exhaust gases from the boiler and the point of discharge of the exhaust gases to the atmosphere.

2. Condensation boiler according to claim 1, characterised in that said airtight duct is of U-shape.

3. Condensation boiler according to claim 1 or 2, characterised in that said airtight duct is provided at its lower part with a conduit for removal of condensate.

4. Condensation boiler according to claim 3, characterised in that the conduit for removing condensate is provided with a float device to prevent discharge of exhaust gases through the conduit when the latter does not contain condensate.

5. Condensation boiler according to any one of the preceding claims, characterised in that the auxiliary exchanger comprises a body of fins, the fins being arranged vertically.

6. Condensation boiler according to claim 5, characterised in that the lower end of each fin of the auxiliary exchanger is of pointed shape to favour flow of condensed water and to keep the passages between the fins free for flow of the exhaust gases.

7. Condensation boiler according to any one of the preceding claims, characterised in that return water from the heating circuit passes through the auxiliary exchanger, the water reheated in the auxiliary exchanger then passing through the principal exchanger before passing to the heating installation powered by the boiler.

8. Condensation boiler according to any one of the preceding claims, characterised in that said airtight duct comprises a hermetic cover to allow access to the auxiliary exchanger.

9. Condensation boiler according to any one of the preceding claims, characterised in that said auxiliary exchanger comprises a plurality of similar planar coils mounted in a skeined configuration and supplied with fluid by a single distributor.

10. Condensation boiler according to claim 9, characterised in that the auxiliary exchanger comprises four coils.

11. Condensation boiler according to claim 9 or 10, characterised in that the assembly of coils is mounted in a parallelepipedal box forming an airtight duct which directs the exhaust gases from the boiler downwardly and which comprises a conduit for removing condensate at its lower part, the condensate passing through the auxiliary exchanger in the same direction as the exhaust gases.

12. Condensation boiler according to any one of claims 9 to 11, characterised in that a partition in a box containing the coils is arranged so as to divide the bundle of coils such that a part of the coils is situated in a conduit for discharge of the exhaust gases.

13. Condensation boiler according to any one of claims 9 to 12, characterised in that the coils are formed of smooth tubes which have no fins.

14. A condensation boiler, substantially as hereinbefore described with reference to Figure 1 or 2, Figure 3, and Figures 4 and 5 or Figure 6 or 7 of the accompanying drawings.

Printed for Her Majesty's Stationery Office by Courier Press, Leamington Spa. 6/1985. Demand No. 8817443.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.